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EXAMINER	
FETZNER, TIFFANY A	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/681,420	Applicant(s) Brittain et al.,
	Examiner Tiffany Fetzner	Art Unit 2862

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) [X] Responsive to communication(s) filed on *Mar 30, 2001*.

2a) [ ] This action is **FINAL**. 2b) [X] This action is non-final.

3) [ ] Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) [X] Claim(s) *1-37* is/are pending in the application.

4a) Of the above, claim(s) ______ is/are withdrawn from consideration.

5) [ ] Claim(s) ______ is/are allowed.

6) [X] Claim(s) *1-35 and 37* is/are rejected.

7) [X] Claim(s) *36* is/are objected to.

8) [ ] Claims ______ are subject to restriction and/or election requirement.

Application Papers

9) [ ] The specification is objected to by the Examiner.

10) [X] The drawing(s) filed on *Mar 30, 2001* is/are a) [ ] accepted or b) [X] objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) [ ] The proposed drawing correction filed on ______ is: a) [ ] approved b) [ ] disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) [ ] The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) [ ] Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) [ ] All b) [ ] Some* c) [ ] None of:

1. [ ] Certified copies of the priority documents have been received.
2. [ ] Certified copies of the priority documents have been received in Application No. ______.
3. [ ] Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) [ ] Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) [ ] The translation of the foreign language provisional application has been received.

15) [ ] Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) [ ] Notice of References Cited (PTO-892)

2) [ ] Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) [X] Information Disclosure Statement(s) (PTO-1449) Paper No(s). 2

4) [ ] Interview Summary (PTO-413) Paper No(s). ______

5) [ ] Notice of Informal Patent Application (PTO-152)

6) [ ] Other:

DETAILED ACTION

1. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. ***Drawings***

3. The drawings are objected to because

A) In description paragraph 20 component 16 is identified as a "display" and then in the next sentence component 16 is identified as a "display". In a patent application all adjectives used to describe a single component should be mentioned the first time the component is identified in order to establish proper antecedent basis. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description:

A) Figure 2 shows a component 114, which is not mentioned in applicant's description. A proposed drawing correction, corrected drawings, or amendment to the specification to add the

reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

5. Applicant is required to submit a proposed drawing correction in response to this Office Action. Any proposal by the applicant for amendment of the drawings to cure defects **must consist of two parts:**

A. A separate letter to the Draftsman in accordance with M.P.E.P. (608.02(r); and

B. A print or pen-and-ink sketch showing changes in red ink in accordance with M.P.E.P. (608.02(v)).

IMPORTANT NOTE: The filing of new formal drawings to correct the noted defect may be deferred until the application is allowed by the examiner, but the print or pen-and-ink sketch with proposed corrections shown in red ink is required in response to this Office Action, and *may not be deferred.*

6. ***Claim Rejections - 35 USC § 112***

7.The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. **Claim 34** (i.e. "maintaining a position of a slab thickness fixed, relative to a magnet of the MR system, during the imaging of the desired FOV and while repositioning the imaging area") recites the limitation "a magnet of the MR system" in line 3 and depends from **claim 28**, but claim 28 lacks teaching that the computer method is implemented on an "MR system" therefore there is insufficient antecedent basis for this limitation in the claim.

Claim Objections

9. **Claim 2** is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. **Claim 2** requires a feature of "exciting and encoding spins to restrict excitation to the selected slab thickness;" that is already an aspect of independent claim 1.

10. Additionally, because **claim 2** is objected to **claim 13** is also necessarily objected to as being of improper dependent form.

11. **Claims 13. And 19** are objected to because of the following informalities:

A) **In claim 13** applicant requires "applying a slab-selective RF pulse to restrict the excitation and having linear phase, sharp transitions, and low in slice ripple to reduce image artifacts from z-dependent variations in phase and amplitude." But the claim as written is unclear. Applicant applies a slab-selective RF pulse to restrict the excitation" (i.e. of what?). Additionally, if applicant means that the "slab-selective RF pulse" has "linear phase, sharp transitions, and low in slice ripple to reduce image artifacts from z-dependent variations in phase and amplitude." This feature needs to be more clearly stated, otherwise the features could correspond to the feature of restricted excitation that appears to be missing from the claim. Appropriate correction is required.

12. With respect to **Claim 19,** this claim is objected two because the words "**and are"** in this claim, are grammatically confusing. (I.e. "transmitting magnetic gradient waveforms to encode a 3D k-space trajectory that is uniform in kz and wherein a number of patient table increments with

z distances that are a multiple of a z-resolution **and are** selected to ensure complete sampling of central z-kx -ky matrix data.") Appropriate correction is required.

13. ***Claim Rejections - 35 USC § 102***

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> > (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

15. **Claims 1-5, 7,** and **18** are rejected under **35 U.S.C. 102(b)** as being anticipated by **Wang** US patent 5,928,148 issued July 27th 1999.

16. With respect to **Claim 1, Wang** teaches and suggests "A method of imaging large volumes without resulting slab-boundary artifacts comprising:"defining a desired FOV" (i.e. the examiner considers the desired large region of interest to be equivalent to applicant's desired FOV) [See col. 2 lines 40-44], because in applicant's specification the 'desired field of view' is the total area that applicant desires to image. The examiner notes that the 'desired large region of interest' in the **Wang** reference is "larger than an optimal imaging volume" (i.e. the series of smaller fields of view which collectively span the desired large region of interest, are considered by the examiner to constitute smaller 'optimal imaging volumes') "of an MR scanner;" [See col. 2 lines 40-44].

17. **Wang** teaches and suggests "selecting a slab thickness in a first direction that is smaller than the desired FOV (i.e. the 'desired large region of interest') "and within the optimal imaging

volume" (i.e. the series of smaller fields of view) "of the MR scanner;" [See col. 5 lines 27-30, where a thickness of 100 to 150mm is taught; col. 2 lines 40-50; col. 7 lines 8-10; and col. 8 line 65 through col. 9 line 17] The examiner also notes that Figure 4 shows a patient being scanned along the axis of the patient table (i.e. the z-axis) and that each of the smaller fields of view in the **Wang** reference is 32-40 cm., while the large imaging region (i.e. the total area under investigation, by the scan using the five fields of view as suggested by Figures 9a and 9b is in the range of 160-200 cm. [See Figures 4, 9a and 9b].

18. **Wang** teaches and suggests "exciting and encoding spins to acquire data that is restricted to the selected slab thickness;" [See col. 5 lines 27-32] Additionally, **Wang** teaches and suggests "acquiring MR data that includes acquiring full encoding data in the first direction for a subset of another two directions;" [See col. 5 lines 24-53 where the acquired data is fully encoded along the y-axis; for a subset" of partial sampling along the kx direction, and a first field of view along the z-direction, therefore **Wang** suggests "acquiring full encoding data in the first direction for a subset of another two directions;".]

19. **Wang** also teaches and suggests "step-wise moving one of the optimal imaging volume and an imaging object;" [See col. 2 lines 40-50; col. 2 line 62 through col. 3 line 10; col. 3 lines 23-27; col. 5 lines 3-7; col. 5 lines 57 through col. 6 line 17; and col. 6 lines 52 through col. 7 line 10] and **Wang** teaches and suggests "acquiring another set of MR data between each step-wise movement until the desired FOV" (i.e. the 'desired large region of interest') "is imaged." [See col. 5 lines 55-67; col. 7 lines 1-22].

20. With respect to **Claim 2**, **Wang** teaches and suggests "the step of exciting and encoding spins is further defined as restricting excitation to the slab thickness." [See col. 5 lines 27-32] The same reasons for rejection, that apply to **claim 1** also apply to **claim 2.**

21. With respect to **Claim 3**, **Wang** teaches and suggests "encoding and filtering data so as to acquire data that is limited to the selected slab thickness." [See col. 5 lines 27-32; col. 4 lines 56-61; col. 4 lines 45-50; and Figure 1] The same reasons for rejection, that apply to **claim 1** also apply to **claim 3.**

22. With respect to **Claim 4**, **Wang** teaches and suggests that "the first direction is in a direction of the step wise movement and is defined as in a z-direction", because conventionally in the MRI / NMR art the z-axis is along the bore of the magnet, therefore Figures 3, 4, 9a, and 9b suggest "step wise movement a z-direction" of the MR magnet bore shown in Figure 1. [See Figures 1, 3, 4, 9a, and 9b]. **Wang** also suggests that "a number of image pixels obtained within the selected slab thickness in the z-direction is at least equal to a number of kx, ky subsets." [See col. 5 lines 26-53; col. 6 lines 62-65; col. 8 lines 5-10; col. 8 lines 57-58; col. 9 lines 2-16] The same reasons for rejection, that apply to **claim 1** also apply to **claim 4**.

23. With respect to **Claim 5**, **Wang** teaches and suggests that the "MR data acquisition between step-wise movements includes acquiring all k-space data in a direction of motion of a patient table for a selected subset of k-space data, in the other two directions." [See Figures 3, 4, 5, 9a, 9b, 1; col. 5 lines 24-67; col. 2 lines 40-50; col. 2 line 62 through col. 3 line 10; The examiner notes that for each Field of view **Wang** teaches and suggests full phase encoding along the y-axis, and partial encoding along z, and that the patient is translated (i.e. moved through) the

entire region of interest along the direction of motion (i.e. the z-axis), therefore in the **Wang** reference subsets of data in the ky and kx directions are acquired at each FOV kz position.] The same reasons for rejection, that apply to **claim 1** also apply to **claim 5**.

24. With respect to **Claim 7**, **Wang** lacks directly teaching that "over-sampling of MR data in the first direction" (i.e. the direction of the patient table motion, or z) "is avoided", however **Wang** shows in Figure 5 that FOV acquisition components 250, 252, and 254 occur between table translations, and in Figure 5 these fields of view do not overlap, therefore Figure 5 suggests that the method of **Wang** is implementable without oversampling. Additionally, Figures 9A and 9B also show that components 214 through 219; do not overlap therefore, Figures 9A and 9B also suggest that the method of **Wang** is implementable without oversampling, even though the reference lacks teaching this limitation directly. [See Figures 5, 9A, and 9B] The same reasons for rejection, that apply to **claim 1** also apply to **claim 7**.

25. With respect to **Claim 18, Wang** teaches and suggests "An MRI apparatus to acquire multiple sets of MR data with a moving table and reconstruct MR images without slab-boundary artifacts comprising: a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field" [See col. 3 line 66 through col. 5 line 53; especially lines 45-61; figure 1], "and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images," [See col. 3 line 66 through col. 5 line 53; especially lines 45 through col. 5 line 20; figure 1], "a patient table movable fore and aft in the MRI system about the magnet bore;" [See

Figures 1, 3, 4, and col. 5 lines 57-67] "a computer" [See Figure 1, col. 3 line 66 through col. 5 line 53].

26. The **Wang** reference suggests that the computer controlled components of the MRI apparatus are "programmed to: receive input defining a desired FOV larger than an optimal imaging volume of the MRI system; define a fixed slab with respect to the magnet to acquire MR data, acquire full MR data in a direction of table motion, defined as z-direction, for a selected kx-ky subset in the fixed slab; increment the patient table while maintaining position of the fixed slab; and repeat the acquire and increment acts until an MR data set is acquired across the desired FOV to reconstruct an image of the FOV", for the same reasons that were already given in the rejection of **claim 1**, since these limitations are just equivalent repetitions of the limitations of **claim 1**, repeated in a format for a computer program, and need not be reiterated.

27. **Claims 1-8, 11, 12, 18, 21-23,** are rejected under **35 U.S.C. 102(b)** as being anticipated by **Yoshitome** Japanese Laid-open Patent Application (kokai) No. H6-311977 disclosed November 8th 1994. [The examiner is using the English version of this reference provided by applicant and submitted with applicant's Information Disclosure Statement].

28. With respect to **Claim 1, Yoshitome** teaches and suggests "A method of imaging large volumes" [See **Yoshitome** H6-311977 page 2 constitution paragraph; page 3 Industrial field of the invention paragraph] "without resulting slab-boundary artifacts" [See **Yoshitome** H6-311977 page 4 problem to be solved by the invention paragraph] "comprising: defining a desired FOV larger than an optimal imaging volume of an MR scanner;"[See **Yoshitome** H6-311977 page 5 Action paragraph 6 sentence 1].

29. **Yoshitome** teaches and suggests "selecting a slab thickness in a first direction that is smaller than the desired FOV and within the optimal imaging volume of the MR scanner;" [See **Yoshitome** H6-311977 page 5 Action paragraph 6 sentence 2], because the examiner considers the term "subregion" in the context of the **Yoshitome** H6-311977 reference to constitute a "slab" with the "plurality of subregions" comprising applicant's "desired FOV that is larger than an optimal imaging volume of an MR scanner". Additionally, the examiner considers the phrase "the length in the direction of each subregion" to be equivalent to the "thickness" of each 'slab' or subregion. [See **Yoshitome** H6-311977 page 5 Action paragraph 6 sentence 2].

30. **Yoshitome** suggests "exciting and encoding spins to acquire data that is restricted to the selected slab thickness;" [See **Yoshitome** H6-311977 page 6 Figure 2, Embodiments paragraph 9 sentence 2] **Additionally, Yoshitome** teaches and suggests "acquiring MR data that includes acquiring full encoding data in the first direction for a subset of another two directions;" [See page 20 Figure 15 component 16B and component 36 "oblique imageable region movement unit 36" of Figure 1 on page 14; **Yoshitome** H6-311977 page 6 paragraph 9 through page 9 paragraph 22.]

31. **Yoshitome** also teaches and suggests "step-wise moving one of the optimal imaging volume and an imaging object;" [See **Yoshitome** H6-311977 page 5 Action paragraph 6] and **Yoshitome** suggests "acquiring another set of MR data between each step-wise movement until the desired FOV is imaged." [See **Yoshitome** H6-311977 page 8 paragraph 19 through page 9 paragraph 22; where oblique imaging is explained].

32. With respect to **Claim 2**, **Yoshitome** teaches and suggests "the step of exciting and encoding spins is further defined as restricting excitation to the slab thickness." [See **Yoshitome** H6-311977 page 6 Figure 2, Embodiments paragraph 9 sentence 2; page 7 paragraph 11.] The same reasons for rejection, that apply to **claim 1** also apply to **claim 2.**

33. With respect to **Claim 3**, **Yoshitome** teaches and suggests "encoding and filtering data so as to acquire data that is limited to the selected slab thickness."[See **Yoshitome** H6-311977 page 6 Figure 2, Embodiments paragraph 9 sentence 2; page 7 paragraph 11; page 9 paragraphs 21 and 22.] The same reasons for rejection, that apply to **claim 1** also apply to **claim 3.**

34. With respect to **Claim 4**, **Yoshitome** lacks directly teaching that "the first direction is in a direction of the step wise movement and is defined as in a z-direction", because **Yoshitome** suggests the direction of motion to be the x-direction, however in applicant's disclosure the z-direction is the direction of movement of the patient, and the slab selection direction, therefore **Yoshitome** x-direction, is interpreted by the examiner as being equivalent to applicant's z-direction, based on the teachings of the reference. [See the entire **Yoshitome** H6-311977 reference and figures] **Yoshitome** also suggests that "a number of image pixels obtained within the selected slab thickness in the z-direction is at least equal to a number of kx, ky subsets." [See **Yoshitome** H6-311977 paragraph 10 on pages 6-7, where the number of pixels in the frequency direction which corresponds to applicant's 'x-direction' and the number of pixels in the phase direction which corresponds to applicant's 'y-direction' satisfy given relationships and enable three-dimensional and oblique imaging over the entire imaging range, (i.e. the number of pixels are at least equal to a number of kx, ky [frequency, phase] subsets, as taught on page 8 paragraph

19, because without the number of pixels being "at least equal to a number of kx, ky [frequency, phase] subsets" three-dimensional and oblique imaging over the entire imaging range, would not be possible. Additionally, **Yoshitome** H6-311977 suggests that the motion data is also encoded in the kx and ky directions because in Figure 15 frequency and phase components (i.e. kx, ky) are taught. The same reasons for rejection, that apply to **claim 1** also apply to **claim 4**.

35. With respect to **Claim 5**, **Yoshitome** teaches and suggests that the "MR data acquisition between step-wise movements includes acquiring all k-space data in a direction of motion of a patient table for a selected subset of k-space data, in the other two directions." [See **Yoshitome** H6-311977 page 8 paragraph 19 through page 9 paragraph 22; Figures 1, 14, 15, 2, 5, and 6.] The examiner notes that for each 'subregion' **Yoshitome** teaches and suggests full phase encoding along all axes, because **Yoshitome** teaches and suggests three-dimensional and oblique imaging over the entire imaging range, and for three-dimensional and oblique imaging, encoding in the frequency and phase directions, as well as the direction of motion is inherently required. Therefore in the three-dimensional and oblique situations the **Yoshitome** reference is considered by the examiner to necessarily acquire subsets of data in the ky and kx directions for "each 'subregion' or "kz position".] The same reasons for rejection, that apply to **claim 1** also apply to **claim 5**.

36. With respect to **Claim 6**, **Yoshitome** lacks directly teaching the step of "continuing to apply the slab selective RF pulse during table movement to maintain a steady-state." However, **Yoshitome** teaches that prior to applying a pulse sequence, a spatial saturation pulse is applied as necessary, to suppress the occurrence of MR signals from regions other than the subregion R(I),

(i.e. the chosen slice thickness). [See **Yoshitome** H6-311977 page 7 paragraph 11] The spatial saturation waveform is considered by the examiner, to be an RF pulse, because in MRI excitation pulses are conventionally radio frequency pulses, and in paragraph 21 **Yoshitome** teaches the use of RF coils and RF receiver filters, therefore **Yoshitome** is detecting RF signals, and subsequently the spatial saturation pulse must necessarily be an RF pulse because the spatial saturation pulse of **Yoshitome** is used to prevent signals from regions other than the subregion R(I), from being detected. The **Yoshitome** H6-311977 teachings therefore suggest that the RF saturation pulse, is applied to: restrict the thickness of the subregion, to ensure that only the selected subregion will be excited, and that the saturation pulse can occur without the patient being completely stopped, (i.e. the saturation pulse may be implemented while the 'movement/imaging alternating execution unit 31, is moving the patient cradle so that the subregion R(I) is within the imageable region 10b of the **Yoshitome** invention, as well as after the motion of the patient cradle has stopped, with subregion R(I) within the imageable region 10b). The examiner notes, that using the saturation pulse 'as necessary, to suppress the occurrence of MR signals from regions other than the subregion R(I),' directly suggests that the **Yoshitome** H6-311977 reference "maintains a steady-state", in the selected subregion direction, and that the patient cradle need not be motionless, at the time the RF saturation pulse is applied. The same reasons for rejection, that apply to **claim 1** also apply to **claim 6**.

37. With respect to **Claim 7**, **Yoshitome** lacks directly teaching that "over-sampling of MR data in the first direction" (i.e. the direction of the patient table motion, or z) "is avoided", however **Yoshitome** suggests that in order to smooth the seams between the subregions that the

boundary vicinities of subregions be gently dropped, and that in dropping the boundaries between subregions that it is necessary to insert part of the neighboring subregions into the imageable region. [See **Yoshitome** H6-311977 page 9 paragraph 21]. This teaching suggests that the method of **Yoshitome** is implementable without oversampling, but that some oversampling in the later processing steps may be beneficial, which suggests that the **Yoshitome** reference is implementable in both a non-oversampling manner, and an oversampling one. Therefore, the **Yoshitome** H6-311977 reference meets the requirements of claim 7, as claim 7 is currently set forth by the applicant. The same reasons for rejection, that apply to **claim 1** also apply to **claim 7**.

38. With respect to **Claim 8**, **Yoshitome** H6-311977 shows and suggests "applying magnetic field gradients that encode a" oblique, or three-dimensional (i.e. "3D") "k-space trajectory that is uniform in a k-space dimension along the step-wise movement (k z)." [See Figures 2, 3, 7, and 15; page 6 paragraph 9 through page 8 paragraph 20; page 12 paragraph 37] The same reasons for rejection, that apply to **claim 1** also apply to **claim 8**.

39. With respect to **Claim 11**, **Yoshitome** H6-311977 teaches and suggests "the step of maintaining a position of the slab thickness" (i.e. subregion R(I)) "fixed relative to a magnet of the MR system during imaging of the desired FOV and the step-wise moving of a table" (i.e. patient cradle 20)." [See **Yoshitome** H6-311977 page 6 paragraphs 8 and 9]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 11**.

40. With respect to **Claim 12**, **Yoshitome** H6-311977 teaches and suggests "selecting a distance of the step-wise movement as an integer multiple of an image resolution in the first

direction." [See **Yoshitome** H6-311977 pages 6,7 paragraphs 9, 10, and 13]. The same reasons for rejection, that apply to **claim 1** also apply to **claim 12**.

41. With respect to **Claim 18, Yoshitome** H6-311977 teaches and suggests "An MRI apparatus to acquire multiple sets of MR data with a moving table and reconstruct MR images without slab-boundary artifacts" [See **Yoshitome** H6-311977 page 4 paragraph 3, where **Yoshitome** teaches avoiding blurring and spurious images or motion artifacts by stopping table motion when an MRI scan is performed, and joins M different images through a single reconstruction operation. Page 4 paragraph 4, page 5 paragraph 6, page 6 paragraph 8 through page 9 paragraph 22.] **Yoshitome** H6-311977 also teaches and suggests, a magnetic resonance imaging (MRI) system having a plurality of gradient coils; [See page 6 paragraph 10; Figures 1, 2, 16] "positioned about a bore of a magnet to impress a polarizing magnetic field" [See Figures 1, 16, and 2], and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images" [See Figures 1, 16, and 2], "a patient table movable fore and aft in the MRI system about the magnet bore;" [See Figures 1, 16, and 2] "and a computer" [See Figures 1 through 7, 16; Page 4 paragraphs 3 and 4, page 5 paragraph 6, page 6 paragraph 8 through page 9 paragraph 22.]

42. The **Yoshitome** H6-311977 reference suggests that the computer controlled components of the MRI apparatus are "programmed to: receive input defining a desired FOV larger than an optimal imaging volume of the MRI system; define a fixed slab with respect to the magnet to acquire MR data, acquire full MR data in a direction of table motion, defined as z-direction, for a

selected kx-ky subset in the fixed slab; increment the patient table while maintaining position of the fixed slab; and repeat the acquire and increment acts until an MR data set is acquired across the desired FOV to reconstruct an image of the FOV", for the same reasons that were already given in the rejection of **claim 1**, since these limitations are just equivalent repetitions of the limitations of **claim 1**, repeated in a format for a computer program, and need not be reiterated.

43. With respect to **Claim 21, Yoshitome** H6-311977 teaches and suggests "applying a slab-selective RF pulse to excite a volume of interest in the z- direction, applying a 3D k-space trajectory to encode the volume interest; and wherein the MR data acquired in the z-direction has a number of pixels that are at least equal to a number of kx -ky subsets", for the same reasons already given in the rejection of **claims 4 and 8**, which need not be reiterated. The same reasons for rejection, and obviousness that apply to **claims 1, 4, 8, 18** also apply to **claim 20**.

44. With respect to **Claim 22, Yoshitome** H6-311977 shows and suggests "applying an RF pulse to excite a volume of interest", for the same reasons previously mentioned with respect to **claim 6** which need not be reiterated. **Yoshitome** H6-311977 shows and suggests "applying a 3D k-space trajectory to encode the volume of interest"; for the same reasons previously mentioned with respect to **claim 8** which need not be reiterated. **Yoshitome** H6-311977 shows and suggests "filtering the acquired MR data to restrict the MR data to the defined fixed slab;" [See **Yoshitome** H6-311977 page 6 paragraph 10 through page 7 paragraph 11; page 9 paragraph 21 and the reasons for rejection with respect to **claim 6**]. **Yoshitome** H6-311977 shows and suggests that "the MR data acquired in the z-direction has a number of pixels that are at least equal to a number of kx -ky subsets", for the same reasons previously mentioned with respect to **claim 4** which need

not be reiterated. The same reasons for rejection, that apply to **claims 1, 4, 6, 8,** and **18** also apply to **claim 22**.

45. With respect to **Claim 23, Yoshitome** H6-311977 teaches and suggests "continuing to apply an RF pulse during table movement", for the same reasons already given in the rejection of **claim 6**, which need not be reiterated." The same reasons for rejection, and obviousness that apply to **claims 1, 6, 18** also apply to **claim 23**.

46. With respect to **Claim 24**, **Yoshitome** teaches and suggests the step of "selecting patient table" (i.e. cradle) increments as an integer multiple of a desired z" (I.e. movement axis) "resolution." [See **Yoshitome** H6-311977 pages 6 through 9 paragraphs 9 through 22; Figures 3, 4, 5, 7, 17,] The same reasons for rejection, that apply to **claims 1, 18** also apply to **claim 24**.

47. With respect to **Claim 25**, **Yoshitome** teaches and suggests the step of "incrementing the patient table in steps having a distance that is a multiple of a z-resolution", for the same reasons already given in the rejection of **claim 12**, which need not be reiterated. The same reasons for rejection, that apply to **claims 1, 12, 18** also apply to **claim 25**.

Claim Rejections - 35 USC § 103

48. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

49. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

50. Claims **10**, is rejected under **35 U.S.C. 103(a)** as being unpatentable over **Yoshitome** Japanese Laid-open Patent Application (kokai) No. **H6-311977** disclosed November 8th 1994; in view of **Yoshitome** Japanese Laid-open Patent Application (kokai) No. **H5-95927** disclosed November 1st 1994;. [The examiner is using the English version of both of these references provided by applicant and submitted with applicant's Information Disclosure Statement].

51. With respect to **Claim 10, Yoshitome** H6-311977 lacks directly teaching that "the 3D k-space trajectory is one of a 3D EPI k-space trajectory, a cylindrical-stack of EPI k-space trajectory, a stack-of-TWIRL k-space trajectory" **However, Yoshitome H5-95927** suggests "a stack-of spirals k-space trajectory, a stack-of projection-reconstruction k-space trajectory, and a 3DFT k-space trajectory." [See, **Yoshitome H5-95927** paragraphs 18, 19, 20 on pages 7 through 8, and Figures 1, 10]. Therefore the combination of **Yoshitome** H6-311977 and **H5-95927** references read of applicant's **claim 10**.

52. It would have been obvious to one of ordinary skill in the art, at the time that the invention was made that the **Yoshitome** H6-311977 reference, can be combined with the **Yoshitome H5-95927** reference because both methods have at least one common inventor, both references teach

a means for imaging an object being moved through an MR device, and both use an "oblique/three-dimensional integrated control unit 16", in performing the image reconstruction. The **Yoshitome H5-95927** reference merely expands on the capabilities of the "oblique/three-dimensional integrated control unit 16" taught in the **Yoshitome** H6-311977 reference, therefore It would have been obvious to one of ordinary skill in the art, at the time that the invention was made that this component is functionally similar in both references, and that the teachings of the two references are combinable. The same reasons for rejection, that apply to **claims 1, 8** also apply to **claim 10**.

53. **Claims 9, 13-17, 19, 20, 22, 28-30, 32-35** and **37** are rejected under **35 U.S.C. 103(a)** as being unpatentable over **Yoshitome** Japanese Laid-open Patent Application (kokai) No. **H6-311977** disclosed November 8th 1994. [The examiner is using the English version of this reference provided by applicant and submitted with applicant's Information Disclosure Statement].

54. With respect to **Claim 9**, **Yoshitome** lacks directly teaching that the 3D" (i.e. oblique) "k-space trajectory has time-varying waveforms" (i.e. RF pulses, or RF magnetic gradients) "during MR data acquisition to minimize overall scan time." However, **Yoshitome** H6-311977 teaches that the readout gradient GF, that occurs as magnetic resonance signals are acquired must satisfy a specific relationship, or when the movement is in the phase direction, a square wave, or waveform of equivalent area must satisfy a different relationship as the phase encoding, which suggests that the "k-space trajectory has time-varying waveforms". [See **Y-shitome** H6-311977 page 6 paragraph 10 through page 7 paragraph 10; which shows the mathematical relations, for

the different gradient waveforms during acquisition; along with Figures 15, 1, and paragraphs 19, 20 on page 8; which suggest the use of time varying waveforms in multiple directions, (i.e. 3D oblique imaging)]. The feature of "minimizing overall scan time", is suggested by **Yoshitome** H6-311977 in paragraph 6 on page 5 because the **Yoshitome** H6-311977 is able to achieve a single image of a plurality of images with a single reconstruction step, as opposed to using multiple reconstruction steps. [See **Yoshitome** H6-311977 page 5 paragraph 6]. It would have been obvious to one of ordinary skill in the art, at the time that the invention was made that the method of **Yoshitome** H6-311977 has "minimizing overall scan time" as a goal because a main goal of the technique is scanning an object that is moved in increments through the MRI device efficiently. [See , **Yoshitome** H6-311977 paragraphs 6, and 8 through 22]. The same reasons for rejection, obviousness, and motivation to combine that apply to **claims 1, 8** also apply to **claim 9**.

55. With respect to **Claim 13, Yoshitome** lacks directly teaching applying a slab-selective RF pulse, to restrict excitation" that has "linear phase, sharp transitions, and low in slice ripple to reduce image artifacts from z-dependent variations in phase and amplitude." However, it would have been obvious to one of ordinary skill in the art, at the time that the invention was made that the saturation pulse taught by **Yoshitome** H6-311977 on page 7 paragraph 11 has "linear phase, sharp transitions, and low in slice ripple to reduce image artifacts from z-dependent variations in phase and amplitude", because **Yoshitome** H6-311977 teaches that in order to smooth the seams between the subregions, created by the spatial saturation pulse that restricts excitation, the boundary vicinities may be gently dropped. [See **Yoshitome** H6-311977 page 9 paragraph 21] The teaching of **Yoshitome** H6-311977 on page 9 paragraph 21 suggests that the slab-selective

RF excitation pulse has "linear phase, sharp transitions, and low in slice ripple" because these features correspond to "the inherent seams between the subregions," implicit to the **Yoshitome** H6-311977 reference, which **Yoshitome** desires to reduce. **Yoshitome** H6-311977 also suggests "reducing image artifacts from z-dependent variations in phase and amplitude". [See **Yoshitome** H6-311977 page 5 paragraph 6 and paragraphs 20, 21 on pages 8 and 9] . The same reasons for rejection, that apply to **claims 1, 2** also apply to **claim 13**.

56. With respect to **Claim 14**, **Yoshitome** teaches and suggests "selecting the step-wise movement distances to acquire complete MR data in each direction." [See **Yoshitome** H6-311977 page 7 paragraph 13, page 5 paragraph 6, and page 6 paragraph 9; Figure 15 component 16B] The same reasons for rejection, that apply to **claim 1** also apply to **claim 14**.

57. With respect to **Claim 15**, **Yoshitome** suggests "transforming MR data in a" motion direction. (i.e. applicant's "z-direction;"). Because in the **Yoshitome** H6-311977 reference the direction of table motion is in the direction, which corresponds to applicant's "z-direction." **Yoshitome** uses the frequency direction "f", the phase direction "p", and the direction of table motion "x". The examiner also notes that what **Yoshitome** H6-311977 refers to as "x" is applicant's "z", and that **Yoshitome** H6-311977 uses "f" as applicant's "x", and "p" as applicant's "y". [See page 7 paragraphs 13 and 14] **Yoshitome** lacks teaching the exact same nomenclature, for the different directions, that applicant uses, however because three-dimensional and oblique imaging is performed by the **Yoshitome** reference, [See figure 15; page 8 paragraph 20] and applicant is concerned with the directions of table motion, phase, and frequency as well, it would have been obvious to one of ordinary skill in the art, at the time that the invention was made that

the directions, and the inventive techniques of the **Yoshitome** reference, and the instant application correspond even though different nomenclature is used.

58. The **Yoshitome** reference, also suggests the step of "sorting and aligning the transformed MR data to match anatomic locations in the first direction to fill a z-kx, ky" (i.e. motion-frequency, phase) "space matrix". [See **Yoshitome** H6-311977 page 5 paragraph 6, where a plurality of images are joined together in a single reconstruction operation. The joined images are aligned to reduce slab boundary artifacts in a "motion" (i.e. applicant's 'z-direction'); page 8 paragraphs 17- 20, page 9 paragraphs 21-22; Figure 15 component 16B] The examiner notes that in **Yoshitome** H6-311977 reference complete phase and frequency data are acquired for each z-position because **Yoshitome** H6-311977 because images of the entire imaging range sagittal, coronal, three-dimensional and oblique are obtained by a single reconstruction. Additionally, because **Yoshitome** H6-311977 moves the table in an "x" (i.e. z-direction) and acquires frequency and phase information to cover the entire imaged range, the **Yoshitome** H6-311977 reference necessarily suggests that "a z-kx, ky (i.e. motion-frequency, phase) "space matrix" is filled with data. The same reasons for rejection, that apply to **claim 1** also apply to **claim 15**.

59. With respect to **Claim 16, Yoshitome** H6-311977 suggests "reconstructing an MR image by transforming the z-transformed MR data in x and y." [See **Yoshitome** H6-311977 page 5 paragraph 6; page 6 paragraph 10 through page 8 paragraph 20, page 9 paragraphs 21-22; Figure 15 component 16B] The same reasons for rejection, that apply to **claims 1, 15** also apply to **claim 16**.

60. With respect to **Claim 17, Yoshitome** H6-311977 suggests "griddling the MR data to reconstruct an MR image." [See **Yoshitome** H6-311977 page 5 paragraph 6; page 6 paragraph 10 through page 8 paragraph 20, page 9 paragraphs 21-22; Figure 15 component 16B] The same reasons for rejection, that apply to **claims 1, 15** also apply to **claim 17**.

61. With respect to **Claim 19, Yoshitome** H6-311977 teaches and suggests "transmitting magnetic gradient waveforms to encode a 3D k-space trajectory that is uniform in kz" for the same reasons already given in the rejection of **claim 8**, which need not be reiterated. **Yoshitome** H6-311977 also teaches and suggests "a number of patient table increments with z distances that are a multiple of a z-resolution" [See page 6 paragraph 9 through page 7 paragraph 10] and are selected to ensure complete sampling of central z-kx -ky matrix data." The same reasons for rejection, that apply to **claims 1, 8, 18** also apply to **claim 19**.

62. With respect to **Claim 20, Yoshitome** H6-311977 teaches and suggests "transforming the MR data with respect to z;" aligning "the z-transformed MR data to match anatomy across slab boundaries, and" transforming "the z-transformed MR data with respect to x and y to reconstruct an MR image". for the same reasons already given in the rejection of **claim 15**, which need not be reiterated." The same reasons for rejection, and obviousness that apply to **claims 1, 15, 18** also apply to **claim 20**.

63. With respect to **Claim 26, Yoshitome** H6-311977 teaches and suggests acquiring "all k data for a selected kx -ky subset;" for the same reasons already given in the rejection of **claim 5**, which need not be reiterated." **Yoshitome** H6-311977 teaches and suggests defining "a set of magnetic field gr adient waveforms to incrementally encode and acquire kz -kx -ky data in a given

slab;" for the same reasons already given in the rejection of **claim 8**, which need not be reiterated because this limitation is just an equivalent restatement of the limiting feature of **claim 8**. **Yoshitome** H6-311977 lacks directly teaching that "the set of magnetic field gradient waveforms in a cyclic order", However it is clear from the **Yoshitome** reference that the motion, frequency and phase gradients are applied at specific times, therefore it would have been obvious to one of ordinary skill in the art, at the time that the invention was made, that the gradients of all three directions which are inherently necessary for the oblique and three-dimensional imaging, of the **Yoshitome** reference are applied in a specific order, over the entire imaging; and therefore the reference suggests a cyclic order to the implementation of the steps in the **Yoshitome** method. [See **Yoshitome** H6-311977 Figures 2, 7, 15; pages 6 through 9 paragraphs 9 through 22; page 4 paragraph 4; page 5 paragraph 6] The same reasons for rejection, and obviousness that apply to **claims 1, 18** also apply to **claim 26**.

64. With respect to **Claim 27**, **Yoshitome** H6-311977 teaches and suggests the steps of "transforming MR data in z; sorting and aligning the z-transformed MR data to match anatomic locations with respect to z to fill a z-kx -ky space matrix" for the same reasons already given in the rejection of **claim 15**, which need not be reiterated. Additionally, **Yoshitome** teaches and suggests the step of "reconstructing an MR image by transforming the aligned MR data in x and y",for the same reasons already given in the rejection of **claim 16**, which need not be reiterated. The same reasons for rejection, that apply to **claims 1, 12, 15, 16, 18, 25** also apply to **claim 27**.

65. With respect to **Claim 28**, This claim is just the corresponding computer programming version of **claims 18** and **19** combined applied to an arbitrary medical imaging scanner, therefore

since the **Yoshitome** H6-311977 MR scanner is a medical imaging scanner, and the movement/imaging alternating execution unit 51 is inherently a computer/processor controlled by a specific inherent operational program, the same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19** also apply to **claim 28** and need not be reiterated. Additionally, It would have been obvious to one of ordinary skill in the art, at the time that the invention was made that the movement/imaging alternating execution unit 51 is inherently a computer/processor controlled by a specific inherent operational program, because in the MRI / NMR art the amount of movement, the timing of the pulses and the number of calculations are to cumbersome for an individual to do by hand, and a computer/processor with an operational program is conventionally a required component of NMR / MRI devices.

66. With respect to **Claim 29**, the **Yoshitome** H6-311977 method shows and suggests "moving a patient table a fixed distance to acquire additional k-space data". [See Figures 1, 2, 3, 7, 17, 4; page 5 paragraph 6; and page 6 paragraph 9] The same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19, 28** also apply to **claim 29** and need not be reiterated

67. With respect to **Claim 30**, the **Yoshitome** H6-311977 method shows and suggests the steps of "moving a patient table a fixed distance for a number of acquisitions until a set of k-space data are acquired for 3D image reconstruction of a given slab; moving the patient table a greater distance, than the fixed distance; repeating the act of image data acquisition for a second slab, and moving the patient table the fixed distance for the same number of acquisitions as for the first slab until a set of image data are acquired for 3D image reconstruction." [See Figures 3, 4, 7,

17, page 5 paragraph 6 and pages 6 through 9, paragraphs 9 through 22]. Additionally, the same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19, 24, 25, 28** also apply to **claim 30** and need not be reiterated

68. With respect to **Claim 32**, the **Yoshitome** H6-311977 method teaches, shows and suggests that "3D k-space data is acquired in z for a subset of kx -ky and wherein the 3D k-space data acquired in z has a number of pixels that is at least equal to a number of kx -ky subsets" for the same reasons given in the rejection of **claims 18, 19 and 21**, which need not be reiterated. The same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19, 21, 28** also apply to **claim 32** and need not be reiterated

69. With respect to **Claim 33**, the **Yoshitome** H6-311977 method teaches, shows and suggests that "moving a patient table in incremental step distances that is a multiple of a z-resolution", for the same reasons given in the rejection of **claim 25**, which need not be reiterated. The same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19, 25, 28** also apply to **claim 33** and need not be reiterated

70. With respect to **Claim 34**, the **Yoshitome** H6-311977 method shows and suggests "maintaining a position of a slab thickness fixed, relative to a magnet of the MR system, during the imaging of the desired FOV and while repositioning the imaging area" for the same reasons given in the rejection of **claim 11**, which need not be reiterated. Additionally, the same reasons for rejection, and obviousness that apply to **claims 1, 8, 11, 18, 19, 28** also apply to **claim 34** and need not be reiterated

71. With respect to **Claim 35**, the **Yoshitome** H6-311977 method shows and suggests that "the RF pulse is a slab-selective RF pulse having linear phase, sharp transitions,.and minimum in-slice ripple to reduce image ghosting from z-dependent variations in phase and amplitude" for the same reasons given in the rejection of **claim 13**, which need not be reiterated. Additionally, the same reasons for rejection,.and obviousness that apply to **claims 1, 8, 13, 18, 19, 24, 25, 28** also apply to **claim 35** and need not be reiterated.

72. With respect to **Claim 37**, the **Yoshitome** H6-311977 method shows and suggests "acquiring all kz data for a selected kx -ky subset; defining a set of magnetic field gradient waveforms to incrementally acquire kz, kx , ky data in each slab, and applying the set of magnetic field gradient waveforms over each slab" for the same reasons given in the rejection of **claim 26**, which need not be reiterated. Additionally, the same reasons for rejection, and obviousness that apply to **claims 1, 8, 18, 19, 26, 28** also apply to **claim 37** and need not be reiterated.

73. **Claim 31** is rejected under **35 U.S.C. 103(a)** as being unpatentable over **Yoshitome** Japanese Laid-open Patent Application (kokai) No. **H6-311977** disclosed November 8th 1994 [The examiner is using the English version of this reference provided by applicant and submitted with applicant's Information Disclosure Statement] in view of **Wang** US patent 5,928,148 issued July 27th 1999.

74. With respect to **Claim 31**, the **Yoshitome** H6-311977 method teaches, shows and suggests that "transforming MR data in z; sort and align the z-transformed MR data to match anatomic locations in z to fill a z-kx -ky space matrix" for the same reasons given in the rejection of for the same reasons given in the rejection of **claim 15**, that need not be reiterated. **Yoshitome**

H6-311977 lacks directly teaching that the transformation is a Fourier Transformation however, Fourier Transformation is the most conventional transformation processed used in the MRI / NMR art and the use of Fourier Transformation is directly taught by **Wang** [See col. 5 lines 10-20].

75. It would have been obvious to one of ordinary skill in the art, at the time that the invention was made that the teachings of **Yoshitome** H6-311977, and **Wang** are combinable because both use MR devices which move the patient, stop, image the patient, and repetitively re-implement these steps until a specific field or view, or region is imaged, and both references transform the data in the direction of patient motion to view the resulting images. Additionally, although the **Wang** method is disclosed for a two-dimensional implementation, use in three-dimensional situations is suggested. [See **Wang** col. 10 lines 28-43] The same reasons for rejection, and obviousness that apply to **claims 1, 8, 15, 18, 19**, **28** also apply to **claim 31** and need not be reiterated.

76. ***Allowable Subject Matter***

77. **Claim 36** is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art does not teach or suggest the combination that the first direction is the z-direction "and that the MR data acquired in the z-direction is represented in a number of **retained pixels**, the number of which is greater than a number of kx -ky subsets, and wherein the RF pulse is continually applied to maintain a steady-state but where MR data is not acquired

during table movement, and wherein the magnetic field gradients encode a 3D trajectory that is uniform in kz."

Conclusion

78. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is (703) 305-0430. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

79. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Lefkowitz, can be reached on (703) 305-4816. The fax phone number for the organization where this application or proceeding is assigned is (703)305-3432 .

80. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-0956.

Tiffany A. Fetzner

TAF

February 5, 2003

EDWARD LEFKOWITZ
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